

**Baltimore Harbor TMDL Stakeholder Advisory Group (SAG)**  
**Data and Modeling Subgroup**  
**Watershed Model Meeting**  
**June 27, 2002**

**MDE**  
**Baltimore, Maryland**

**Welcome:**

Robin Grove, Director of TARSA, provided opening remarks expressing his gratitude to the stakeholders for taking the time to participate in the TMDL outreach process. His expectation is that stakeholder input will improve the overall quality of the TMDLs currently being developed.

**First Presentation – HSPF Model presented by Shan Abeywickrama**

**Topics:**

- ❖ Hydrology Calibration
- ❖ Water Quality Calibration
- ❖ Comparison between MDE and CBP HSPF models

Questions and answers during presentation:

- Q: Steve Dyer – What was the most recent year that precipitation data was used?
- A: Shan Abeywickrama – The precipitation data set used is from 1992-1998
- Q: Steve Cohen – Why was the time frame of 1992-1998 chosen for the precipitation data set?
- A: Shan Abeywickrama– The 92-98 time frame was chosen to coincide with the time frame used in the Harbor water quality model and also to allow the model a couple of years to stabilize (spin up).
- Q: John Kearns – What is the definition of urban vs. non-urban land uses? And, how do the definitions effect how the model interprets various land use patterns?
- A: Shan Abeywickrama– Within the model each land use is modeled differently. For example, through different soil and runoff characteristics
- Q: John Kearns – Follow on – The watershed has been characterized as urban, and the BWI rainfall data is said to represent an urban watershed. Yet the northern section of the watershed is not urban – why is the BWI gauge being used to represent non-urban lands?
- A: Miao-Li Chang – The majority of loads entering the harbor is from the urban environment. The watershed model simulates the loads from different land uses within the watershed including urban. It does not mean that BWI rainfall data only represent an urban watershed. After using BWI rainfall data, the model does a fairly good job of simulating the watersheds hydrology.

Lee Currey – The BWI gauge was chosen because the data was recorded in hourly intervals. This eliminates the need to disaggregate daily data that was available from other gauges. Also, the hourly recorded data does present a fair representation of the “flashy” characteristics often associated with urban stream environments. Disaggregation can result in spatial discrepancies since the temporal disaggregation pattern is based on another gauge. Theissen polygon methods can result in averaging of peak intensities.

Q: Beth McGee – What is flow frequency?

A: Lee Currey – Flow frequency is calculated by taking the flow calibration data and actual USGS gauge data and sorting them from highest to lowest values, and then plotting the separate cumulative frequency distributions. Next the two cumulative frequency distribution plots are compared (model vs. observed).

Q: Steve Dyer – Regarding hydrology calibration results – Are MDE and CBP using the same data with the two different models and getting different results?

A: Shan Abeywickrama – The CBP and MDE model are not calibrated using the same data. Although the models are of the same type (HSPF), they are using different input parameters (e.g., segmentation, scale).

Q: Steve Cohen – Are the results from the MDE modeling effort going to be used in the CBP model?

A: Shan Abeywickrama– Yes, to the extent that in Phase V of the CBP model (due out in 2005), MDEs results will be taken into account – the goal of the modeling effort between MDE and CBP is to create one model in the areas where both agencies are working.

Q: Beth McGee – Since the USGS flow gauges used in the calibration are pretty far upstream, how confident do you feel that you are modeling what is occurring downstream?

A: Shan Abeywickrama– HSPF does not have the capability to model tidally influenced waters, therefore the gauges that were used are above the extent of tidal influence.  
Lee Currey – The goal of the model is to simulate the general trends that are occurring in the watershed. The three USGS gauges used vary in upstream land use distribution. They range from urban to forest and agricultural. Using these three flow gauges for calibration allows model input parameters (per land use) to be representative throughout the entire watershed.

Q: Barbara Bachman – Where does industrial land use fit within the model?

A: Shan Abeywickrama– Land that contains industry is classified in the Commercial/Industrial category.

Q: Steve Cohen – If the flows of the tributaries are slowed by tidal influence, will the results of the model be impacted?

A: Lee Currey/Miao-Li Chang – Tidal influence will not impact the results of this watershed model. The tidal impacts on the tributaries will be accounted for in the harbor water quality and hydrodynamic models.

Q: Steve Dyer – Looking at the data presented, and the model hydrology output, it looks like the model is predicting higher levels of flow than the data, is this error going to be corrected or is it going to be carried throughout the model?

A: Lee Currey/Miao-Li Chang – Models are constructed to provide information about environments that do not have enough data to describe exactly what is occurring. To accomplish this, assumptions and professional judgment must be used to determine the level of information needed to construct the model and the statistical analysis that indicates that the model is performing correctly – that is within a reasonable range of acceptable values.  
To construct the model we did not specifically curve fit the calibration to any particular flow gauge data. We based changes in parameters on changes in land use, topography and soils and thereby tried to make the model more representative of a variety of these combinations. This may result in error when looking at each gauge individually, (or adjusting model input parameters for each gauge) but will provide a better representation of the watershed system when using more physically based parameters for all 3 gauges.

Comment: John Kearns – Statistical analysis such as Monte Carlo simulations can be used to provide a sensitivity analysis of the models overall performance.

Q: John Kearns – Are the water quality samples surface water samples? How do the locations of the samples compare with the gauging stations?

A: Shan Abeywickrama– The samples are in-stream grab samples collected in the non-tidal areas.

Q: Bill Rue – Were the Baltimore City stormwater samples “first flush” samples (i.e., taken at the beginning of a stormwater runoff event)?

A: Lee Currey – We are unsure of when in the storm event the samples were taken. Some Baltimore city samples were collected over the period of the event. That is why the model is calibrated against EMCs instead of individual sample values.

Q: John Kearns – Do you know how much of the water discharged through point sources in the Harbor is from outside the watershed? If so, is it significant and has it been accounted for?

A: Lee Currey/Miao-Li Chang – We have not accounted for the importation of water from outside the watershed. We do not know the significance of this flow to the receiving water quality model yet. However, MDE is planning to conduct a sensitivity test of the water quality model in one of the TMDL scenario runs. The water quality model includes the transfer of flow from Back River WWTP to Bethlehem Steel.

Q: Steve Cohen – Was there any attempt to adjust nutrient loads based on the number of failing septic systems?

A: Shan Abeywickrama – An attempt was made, as a result it was determined that the information available was insufficient to conduct a quality analysis. Therefore, the loads were not adjusted.

Q: John Kearns – Regarding the flow of point sources – is the flow of these sources, particularly if they are from outside the watershed, significant enough to be accounted for in the model?

A: Shan Abeywickrama/Miao-Li Chang –The water discharged from the point sources, regardless of origin, will be accounted for in the water quality model. Aside – most point sources in the city receive water from within the watershed or from the Baltimore City supply (Gunpowder River watershed).

Comment: Group – The accounting of water within the watershed and water quality models needs to ensure the loads are accounted for correctly.

A: A review of the flows will be conducted to ensure that loads are properly accounted for in the various models.

Q: John Kearns – Is there any municipal sewage sludge land application in the watershed? If so has it been accounted for in the calculation of acres that receive manure?

A: Shan Abeywickrama– I don't believe that any municipal sludge is applied in the watershed, however I will research that issue and make the necessary adjustments as needed.

Q: Steve Dyer – What is the impact of Nutrient Management Plans and nutrient management in general, on the nutrient loading factors used to calculate NPS runoff from agricultural lands? Given that the NMPs are fairly new, whatever was the law during the calibration period should be used to calculate runoff rates. Also, it would seem that the implementation of nutrient management would change the runoff rates of nutrients from the lands under management, how will that be accounted for?

A: Shan Abeywickrama – The model is calibrated to in stream ambient water quality conditions. Therefore, nutrient management BMPs are implicitly considered when calibrating to the in-stream data.

Q: Steve Cohen – Given that the NMPs are supposed to improve water quality - is the model going to be updated to reflect the changes management policies to reflect both agricultural and stormwater BMPs?

A: Miao-Li Chang –Various policy changes will be used in the scenario development phase of the modeling. The goal will be to use the models to predict what changes will occur to nutrient loads when loads and coefficients associated with previous practices are adjusted.

- Q: Beth McGee – What about groundwater as a source of nutrients?
- A: Shan Abeywickrama– The HSPF model does consider groundwater in the water and nutrient balance.
- Q: John Kearns – Re: the calibration of the model – are the literature sources that were used as a comparison actual measured values or assumptions?
- A: Shan Abeywickrama/Miao-Li Chang/Lee Currey – The values within the literature are both the result of actual measurements, and other modeling studies conducted by the city and county.
- Q: Bill Rue – Have you compared the regional specific rates that you generated to HSPF model coefficients and results outside the region? If so, are they in the same ballpark?
- A: Shan Abeywickrama – It depends on the parameter, in some cases they match well, while in other instances there were some discrepancies.
- Q: Barbara Bachman – How do you relate the presented NPDES data to the units of lbs/acre/yr?
- A: Lee Currey – In this case the NPDES data is from the NPS program and is reported in those units. More recent NPDES non-point source permits require an estimate of the land use loading rate from a particular site. This is typically derived from the water quality and flow samples and usually calculated from the EMC.
- Q: Bill Rue – Given the comparison between MDE and CBP model numbers, will you be using MDE numbers in the future?
- A: Shan Abeywickrama – Yes, we will be using MDE numbers to generate MDE's nutrient TMDLs for Baltimore Harbor and Back River.
- Q: Bill Rue – Based upon the data that has been presented, how do the delivered loads that you have determined compare to what might be required by the CBP as a load to the Patapsco River? Do these number show problems or not?
- A: Shan Abeywickrama – We are unsure at the moment. However, when the water quality model begins to run it will use these watershed loads as input. If there are significant differences between the loads assigned to the Patapsco River from MDE and CBP, it will probably materialize when the water quality model produces results.  
Miao-Li Chang – From this point forward MDE and CBP will be working together to ensure that these discrepancies do not occur again. But, the nutrients TMDLs for Baltimore Harbor and Back River will be completed based on MDE outputs.
- Comment: Miao-Li Chang – MDE has conducted several internal and external peer reviews of the HSPF and SWMM models, and it is important for the agency's timetable to complete

these models in the near future. Therefore, following this session we will review comments, and when addressed we will consider these models completed.

**Second Presentation Overview of SWMM Model – Presented by Lee Currey**

- ❖ Hydrology Calibration
- ❖ Water Quality Calibration

Q Beth McGee – So why is it that you are using two models to complete this work?

A: Lee Currey – The SWMM model is an urban stormwater model, which is well suited for modeling metals and TSS wash off in this watershed. Also, there are several existing studies within the watershed using SWMM, which allowed MDE to enhance the existing body of work. Also, SWMM is listed by EPA as an approved model for TMDLs.

Q: Bill Rue – Ultimately, are you working on predicting mean values of loads?

A: Lee Currey - Yes

Q: Bill Rue – Regarding build up and wash off – how is build up defined?

A: Lee Currey– Build up is the surface deposition of material over time, the rate of deposition is set at a constant, and accumulation amount can be set to a maximum level to help limit the model parameters. We defined the wash off rates based on literature values for the specific metal. Therefore the only adjustment was to the build up rate. Since we are calibrating to land use EMC and unit load rate, by adjusting only this one parameter we can get a unique solution. Further, the EMC is calculated by dividing the total annual wet weather load by the total annual wet weather flow. This strengthens the dependence of the results on the build up rate while allowing wash off parameters to be set based on literature values. Typically from sampling events the EMC is calculated as an average of all sampled events for the year. We compared this calculation method to the first method described and results were acceptable.

Q: Bill Rue – Are the Event Mean Concentrations (EMCs) based on data? If so when were the data collected?

A: Lee Currey– The NPDES nonpoint source data is based on actual samples. The samples were collected throughout the storm event hydrograph and provide a flow weighted calculation of EMCs.

Q: Bill Rue – Where is copper going to come out in this whole process?

A: Miao-Li Chang– At this point we are working from the 1998 303(d) list, in which copper is not listed as an impairment. We are aware that copper may be a problem but cannot answer concretely at the moment on whether or not we will do a TMDL. We are waiting on data that is currently being processed to determine what direction we will go next regarding copper.

- Q: John Kearns – What assessment and verification was conducted on the data prior to it being used in the models. If the data showed any particular bias, what impact would that have on your model?
- A: Lee Currey – This point was raised in CBP's Urban Workgroup when looking at urban NPDES loading data. In this case we didn't go back and review the detection limits, we took the NPDES reports and looked at them in aggregate in an attempt to reduce any bias.
- Q: John Kearns – Do we know how sensitive the model is to errors in the data?
- A: Lee Currey – We have not conducted that type of an analysis.
- Q: Cece Donovan – Who are the authors of the NPDES nonpoint source data reports? Where do they sample during these events? Do you know if there are certain procedures for collecting 'first flush' samples?
- A: Lee Currey – Local jurisdictions produced the reports. Samples are collected from stormdrain outfalls and in-stream locations. There are certain procedures for collecting during storms but there is a fair amount of variability that goes into how samples are collected.
- Q: John Kearns – Why is the relationship between TSS and metals loadings not positive in this environment? That is, metals loadings are generally positively correlated to TSS loads. However, the data you have presented describes the majority of sediment coming from agricultural land uses while the majority of metals loads are coming from urban land uses. Is it possible that the lower sediment loads in the urban environment deliver significantly higher loads of metals to the harbor?
- A: Lee Currey – Urban land uses generally follow the relationship that you described, however when you factor in the Patapsco segment of the model that is dominated by nonurban land use the relationship does not hold. The large loads of sediments from agricultural land uses do not, in general, contribute high loads of metals.
- Beth McGee – What this implies is that the sediment in the urban environment has a higher concentration of metals on a per particle basis.
- Scott Macomber – If the source of metals is the urban environment, yet the source of the sediment is non-urban, the metals will be bonded to the sediments that are available from the urban environment – at higher concentrations.
- Q: John Kearns – Given that the model is using a build up/wash off method, the premise is that particles from automobiles etc. have a much higher load of Zn, Pb, and Cr than particles in a farm field?
- A: Group – Right, also the population and density of urban environment will lead to higher loads and concentrations between land uses.

John Kearns – based on this situation, it would mean that, for instance, the load of Zn on a particle is 4X's higher on urban sediment than from an agricultural farm field.

Beth McGee – Yes

Bill Rue – Also, Zn is available in the soluble phase and should not be considered just a particulate phase issue.

Q: Steve Dyer – Is the baseload concentration reflective of groundwater?

A: Lee Currey – Groundwater is part of the baseflow condition that is dealt with in the model.

Q: Steve Dyer – How is the model dealing with the resuspension of sediments?

A: Scott Macomber – The resuspension issue will be addressed using water quality model. The process begun today will lead to that conversation in the future. The goal is to build a base for the group to move forward from during the next couple of meetings when the water quality model will be discussed in detail.

Lee Currey – We tried to limit the level of complexity with the watershed model. The watershed model is used to estimate NPS loads to the receiving water quality model only.

Bill Rue: When we get to the water quality model, I would appreciate a similar meeting to this to discuss the regulatory implications and other assorted issues. For instance, the regulatory issues of comparing loading results from 1hr average acute to 4 day average chronic or dissolved vs. total (because the standards are listed as dissolved).

Miao-Li Chang – The listing in the Harbor is due to sediment impairments, therefore the endpoint will be total metals. MDE is working in house to develop a methodology to determine the endpoints for sediment impairment that incorporates sediment triad data (sediment concentration, toxicity, and benthic integrity) instead of using sediment concentration only. And yes, there will be a similar meeting for the review of the water quality/toxics model when it is available.

Q: Beth McGee – Will the endpoint discussion be part of the SAG discussion?

A: Miao-Li Chang – It will depend upon time constraints, we expect to provide updates and will plan time for a discussion.

Q: Bill Rue – If the TMDLs will be based on sediment endpoints, ultimately you are going to attempt to restrict loadings from sources and the issue of legacy pollutants becomes extraordinarily difficult issue to handle

A: Agreed

Q: Steve Dyer – How is MDE handling less than detection limit (DL) values?



A: Scott Macomber – In the point source load calculations that we have conducted to date, we have input both a zero and the detection limit to develop a range of loads.

Bill Rue – In the estimates that are being developed, if you could ensure that the zero and detection limit procedure is used to generate a range, that would be useful.

Scott Macomber – Where it is appropriate (i.e., the data are <DL and we have the DL) we will develop a range.

John Kearns – >15% substitute values for Non Detects in a database can create a significant amount of error.

Jim George – We have to ask what the significance of this issue is when compared to the overall modeling and data gathering process. MDE is sensitive to this concern, and we will be mindful of this when we are developing the load estimates, however the use of DL and <DL will be evaluated further within the overall value of the modeling exercise. This issue also depends on the volume of the discharge – a facility with a minor discharge <DL calculation issue does not have the same impact as a significant discharge facility with a <DL issue.

Action Item: Upload presentations and minutes onto website, email everyone to alert them of the upload.